AUGUST 1986

IMTS Pre-Show Issue

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FOR MANAGERS OF MANUFACTURING TECHNOLOGY

15 TOP MANUFACTURING MANAGERS TALK ABOUT THE CHALLENGES OF THE FUTURE

SPEAK OUT!

"...is revolutionizing the world... virtually every aspect of manufacturing is being impacted. And, to make matters even more challenging, technological development is accelerating." JAMES A.D. MEYER, Chairman & CEO, Blackstone/Hillcrest Inc.

FMS:
Where the Action is

Automated Parts Identification:
On the Verge of a Boom

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AUGUST 1986 COVER-TO-COVER VOL. 98 NO. 2

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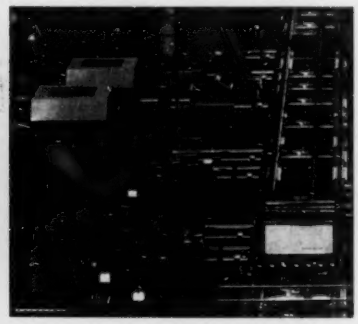

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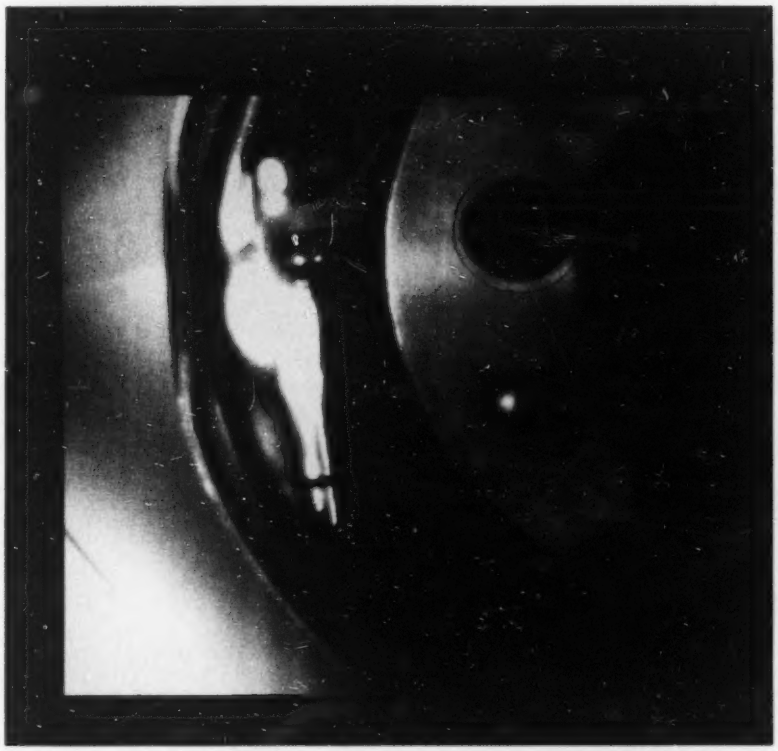
MIDWEST

Machine Vision Eyes its Future

—Sales of machine vision products totalled $58 million in 1985 and will reach $457 million in 1990.
—Systems incorporating machine vision will grow from $188 million in 1985 to more than $2 billion in 1990.
—Gaging functions comprise the largest share of the vision market today, with inspection expected to comprise as large a share by 1990.
—Automakers make up the largest single market today, but electronics will surge ahead in 1990, with 36 pct of the market share.
—95 pct of the vision units in the U.S. are produced domestically. By 1990 this figure will be about 50 pct.
—Depending on application, the cost of a typical basic machine-vision unit ranges between $25,000 and $50,000. In 1990, the range will be $15,000 to $35,000.



An array of Diffracto Advanced Technology Z-Sensor cameras checks welded auto bodies at the Vision Show. Such systems are capable of 100 pct checking of the welded assemblies, detecting stamping accuracies and location of features such as holes to accuracies of .002 in.

All of these conclusions are based on an extensive Delphi study conducted by the University of Michigan for the Automated Vision Association. The findings were announced at the Vision '86 Conference & Exposition at Detroit's Cobo Hall, sponsored by the Society of Manufacturing Engineers and the Robotic Industries Association's vision affiliates.

Though the conclusions of the study are, for the most part, rosy, and industry growth seems assured, it is not all without trouble.

Outgoing association president James K. West, vice president, Perceptron Inc., said: "I feel that as leaders, we must own up to the fact that this promising industry is in a bit of trouble. The trouble stems from the fact that there are so few successful machine vision companies. This fact leads to increased skepticism on the part of Wall Street, which then encourages risk capital to seek more potentially fruitful fields for future investment."

As a result, many of the current vision companies are undercapitalized and survival will be a struggle for most of the small companies in the industry, according to industry analyses. Some guesstimates are that the current list, which could be as high as 200 is made up of only a dozen or so strong companies with successful applications to show. Of these, only about half a dozen companies made a profit on their vision business last year, or will in 1986. Drastic reductions in the number of companies in the industry seem inevitable.

"There will be fewer companies at the end of this year in this industry than there were in the beginning," said Michael Cronin, president, Automatix Inc.

The University of Michigan Delphi study showed that most vision systems are for gaging, with inspection a close second, and that for the balance of the '80s, the patterns will change little. The findings:

Despite the fact that "process control" comes in at the bottom (See chart), some of those who indicated "inspection" may also be thinking of machine or process control. Gerald L. Elson, executive director, Artificial In-

telligence, Advanced Engineering Staff, GM, said his company now has several hundred vision systems in a wide range of plants on a variety of application. "We can see the time when our total number of systems might be on the order of 40,000. Most will be used for machine or process control. By that I mean that we'll be inspecting parts and assemblies immediately after an operation, and then using the information real-time to make necessary process or machine corrections. We'll be inspecting, but we'll also be closing the loop."

Although the show did feature a number of new products, the emphasis seemed to be on applications, including the analysis of surfaces, gaging of dimensions to accuracies of—in some cases—tenths of a thousandth of an inch, checking part presence and orientation, and in several cases the guiding of robots. In fact, several spokesmen predicted that robots of the future will include vision as a standard sensor. It will be cheaper to use vision to track a part or to position the gripper than it will be to create the equivalent precision in robot rigidity and precision and to furnish software capable of doing the same job, according to one industry spokesman.

Perceptron's West comments: "The industry is still a child, but we have it in a very tough war where the performance demands create the most difficult challenges at every turn. What we now need are users who have a better understanding of the 'art' of vision, and who are willing to take the risk of applying it." The risk, in the right cases, might be minimal. The U of M study shows payback periods of less than 18 months as common.

"The industry today is somehwere in the second or third stage of a four-stage development curve." said Pierre Payne of Allen-Bradley. Mr. Payne, manager, commercial marketing, Sensing Products Business for A-B, explained that Phase 1 is the initial research and development phase in which hardware and software are proved possible and some experimentation on applications is tried. During Phase 2, the inventor/entrepeneur makes general prototypes and takes them to market ("an essential step because no one else knows how to do it"). Phase 3 is that stage at which the products, both hardware and software, are available as general-purpose products which can be tailored by systems integrators (third parties) for specific solutions. That, stressed Mr. Payne, is Allen-Bradley's current position.

Finally, through substantial education and experience, Phase 4 is represented by users who are capable of taking standard, modular elements of a system and doing their own application engineering. "At this stage, the high cost of customizing and application engineering by suppliers will be reduced or eliminated and the prices will go down at the same time sophistication is going up, Mr Payne added.

Incoming president of AVA, Pat V. Costa, president and CEO at Robotic Vision systems Inc., acknowledged the need for education. "Our industry Delphi study shows that the single largest barrier to the implementation of machine vision is a lack of user expertise in developing applications."

Gould's new VS-1700 vision system is used to identify an automotive camshaft, which controls a multiple-programmed cam grinder.

Shipments of Machine Vision Systems, by Specific Application

	Percent of Unit Sales		
	1985	1987	1990
Verification	11	7	6
Counting	5	3	2
Character Recognition	7	6	6
Identification	7	6	5
Sorting	7	6	4
Gaging	27	27	24
Inspection	20	22	24
Flaw Detection	7	7	12
Adaptive Control	1	6	7
Seam Tracking	4	4	4
Process Control	4	6	6
Other	0	0	0
	100%	100%	100%

Mack and Dana Sign 10-Year Agreement

Mack Trucks, Inc., Allentown, Pa., and Dana Corp., Toledo, Ohio, have signed a letter of intent providing for an extended-term business agreement.

Under the terms of the 10-year agreement, Dana will manufacture and supply Mack's requirements for complete front and rear axles, clutches and frame assemblies for use at Mack's assembly plants and in Mack's parts and service operations.

Dana has been a supplier to Mack for the past 80 years, providing over $100 million in parts to the heavy-duty diesel truck manufacturer yearly. Dana projects that as the agreement is phased in, that figure will double, based on today's prices.

As part of the agreement, completed frame assemblies with axles mounted, will be supplied to the Mack assembly facilities on a "line-set" basis to a Just-In-Time (JIT) schedule.

Dana currently operates a JIT assembly plant in Lancaster, Pa., supplying Mack's facilities in Allentown and Macungie, Pa. Mack axles are assembled there, using housings supplied by Dana and carrier sections, including drive gears and differentials, supplied by Mack. Under the new agreement, Dana also will produce the carrier section.

Mack's requirements for its new $80 million assembly facility currently under construction in Winnsboro, S.C., will be provided from a new Dana manufacturing plant also to be constructed in South Carolina near the Mack facility. Dana has not yet selected a site for the proposed 100,000 sq. ft. facility which is planned to employ 100. Both new plants are scheduled to be on-line by mid-1987.

Additionally, Mack and Dana will jointly further develop the electronic communications network which links the companies' financial and operating computer systems.

Metalworking Industry Capital Spending (Billions of Dollars)

	1985	1986F	1987F	Percent Change 1985–86	Percent Change 1986–87
Fabricated Metal Products	3.57	3.80	4.00	6.4	5.3
Nonelectrical Machinery	15.83	16.70	18.30	5.5	9.6
Electrical Machinery	15.57	15.90	17.60	2.1	10.7
Motor Vehicles and Parts	14.01	15.40	16.90	9.9	9.7
Aerospace	3.50	4.00	4.50	14.3	12.5
Instruments	3.80	4.10	4.40	7.9	7.3
Total	56.28	59.90	65.70	6.4	9.9

F = Forecast

Source: U.S. Department of Commerce, The Conference Board, Merrill Lynch Economics

Merrill Lynch is Bullish On Machine Tool Industry

Despite a sluggish first half, the balance of this year and all of 1987 show prospects for stronger economic growth as a result of moderating interest rates, substantially lower oil prices and some improvement on the import/export front. That's the conclusion of a "Machine Tool Outlook" report prepared by Merrill Lynch Economics Inc., New York.

The report concludes that capital spending in real terms will increase 4 pct this year and an additional 5 pct in 1987. "While lower oil prices are a net positive on the overall economy, they are causing substantial cutbacks in capital spending programs within the petroleum industry. A decline in investment by the petroleum industry of approximately 25 pct this year and 10 pct in 1987 is projected according to the report."

Other conclusions from the report:

—The Reagan defense built-up will continue to have a beneficial impact on the economy over the near term.

—Metalworking industries should experience a pickup in product demand over the near term with the single exception of the motor vehicle industry which will see production and sales decline modestly from their robust 1985 levels. Improved earnings in the metal working industries will stimulate action on existing capital projects and the initiation of new capital programs.

—Domestic producers of machine tools should see a pickup in orders and shipments reflecting an expanding U.S. market and some moderation in the flow of machine tools from overseas. The moderation of imports is based on the assumption that the drop in the value of the dollar and pressure from the administration will limit import penetration.

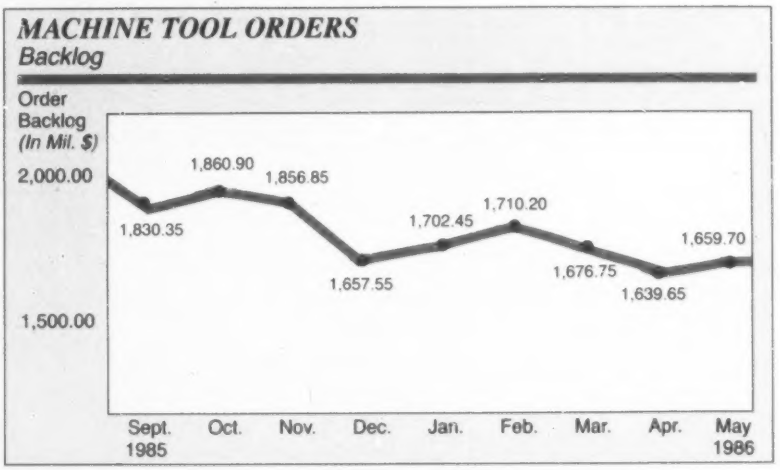
—Prospects for growth in overseas industrialized economies have improved, especially in the light of the decline in oil prices. This, in conjunction with a weaker dollar, will support U.S. efforts to export machine tools. Merrill Lynch now projects an increase in domestic machine tool orders of 22 pct this year and 23 pct in 1987. That projection is based on assumptions regarding increased activity by both the motor vehicle and aerospace industries than existed in 1985.

The Merrill Lynch report anticipates continuing advances in consumer spending; real consumer spending will reflect 3 pct gains in income both this year and next versus a 1½ pct gain in 1985 plus a perception on the part of the consumer that the individual financial net worth has improved.

In summary, Merrill Lynch anticipates that new plant and equipment expenditures by business in real terms will jump from 1985's approximately 377.5 billion to 393 billion this year.

WASHINGTON

Machine Tool Orders Surge In May



May orders for machine tools totaled $207.20 million, up 7.2 pct from April's figure of $193.25 million, according to the National Machine Tool Builders' Association (NMTBA). The biggest gain was in metal forming orders which rose 12.1 pct to $64 million from $57.10 million the previous month. Metal cutting orders rose from $136.15 million to $143.20 million, a 5.2 pct increase.

Despite the monthly rise, year-to-date orders for both metal cutting and metal forming machinery showed a decline from 1985. Metal cutting machine tool orders dropped from $821.35 million in 1985 to $742.85 million in 1986, a 9.6 pct decrease. Orders for metal forming equipment dropped from $313.10 million to $273.35 million for a loss of 12.7 pct. Total orders fell from $1,134.45 million to $1,016.20 million, a 10.4 pct drop.

"While it is good to see a rise in orders for May, it is important to maintain your perspective when considering these figures. The positive news that orders are up for the month is offset by the fact that orders through May are down 10.4 pct compared to a year ago," James A. Gray, president of the NMTBA, pointed out.

Total shipments of cutting and forming machinery rose by 8.4 pct for the month of May, up to $227.25 million from the $209.55 million posted in April. Almost all of the gain was in metal cutting shipments which rose to $169.70 million, an 11.6 pct gain over the previous month. Metal forming maintained a shipment level comparable to a month ago, rising from $57.45 to $57.55 for a 0.2 pct gain. Total cutting and forming shipments showed a 17.7 pct rise for the year compared to the same period in 1985.

Industry backlogs dropped from $1,659.70 million in April to $1,639.65 in May.

NTMA Projects 5 Pct Increase in Contracts

The outlook this year for the contract tooling and machining industry is expected to be up about 5 pct over last year, latest figures from the National Tooling and Machining Association indicate.

Previous forecasts had 1986 sales as merely equal to those of last year. However, the recent sharp declines in oil prices have convinced association forecasters to change their outlook, the NTMA said.

Although the forecasters do not see oil price declines (along with other recent economic improvements) creating substantial expansion in NTMA markets, the combined beneficial impact greatly reduces the chances for a recession beginning later this year.

The second and third quarters have the potential for producing stronger NTMA business prospects than this year's first quarter did, the association projected. Although few NTMA companies are likely to experience great sales expansions this year, according to the NTMA, fewer than had been predicted will experience marked downturns in business later this year.

The 5 pct projected increase in overall sales (shipments) will affect individual association sectors as follows: Molds are now projected to grow by 5 pct; tools, dies & fixtures, up 8 pct; and aerospace machining and fabrication is predicted to increase 12 pct over 1985. General precision machining and special machines are both expected to drop 5 pct however.

Prospects for major NTMA customer markets remain strong this year, the poll showed. New orders in dollar volume are expected to be higher in each of the major customer market sectors. Electronic components sales are now expected to rise 15 pct this year rather than the previously predicted 12 pct.

New order forecasts for motor vehicles and parts, aircraft, space vehicles and missiles and construction, mining and oil field equipment remain unchanged from previous forecasts and are still expected to be up by 3 pct, 10 pct and 5 pct, respectively.

Household appliance orders are still projected to increase by 6 pct this year, however, this could be revised upward by the next quarter if the current economic upswing continues, the association said.

–Washington, D.C. reported by Ed Bowers/Maryland

Automated Parts Identification: On the Verge of a Boom

While bar coding is the most popular, an assortment of other technologies are competing for a larger share of the market.

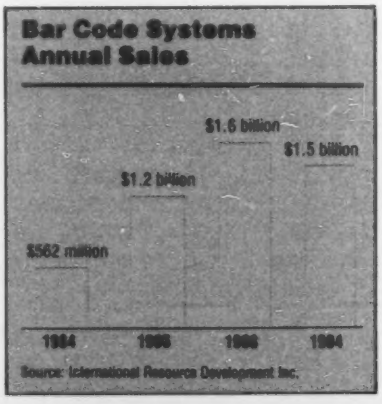
By Al M. Senia
West Coast Editor

WITH MANUFACTURERS DESPERATELY seeking cost improvements and production enhancements, the domestic automated parts identification systems industry appears to be heading for a boom.

The technology to automatically track parts and inventory actually has existed for more than 25 years. It first appeared when Sylvania developed an automated symbol to aid in identification of railroad cars in 1960.

Since then, the technology gained growing appeal in a number of select markets: supermarkets (in the 1970s), libraries, the health professions and other service industries. The ubiquitous bar code symbol now has become familiar to American consumers.

If corporate officials and analysts are to be believed, manufacturers are poised to discover the benefits of automatic identification systems in a large way. The technology is being touted as a major means of accurately tracking virtually any part through production, warehousing or distribution. Lower direct labor costs, more accurate audits and higher factory productivity all are touted as major benefits of the automatic identification technologies.

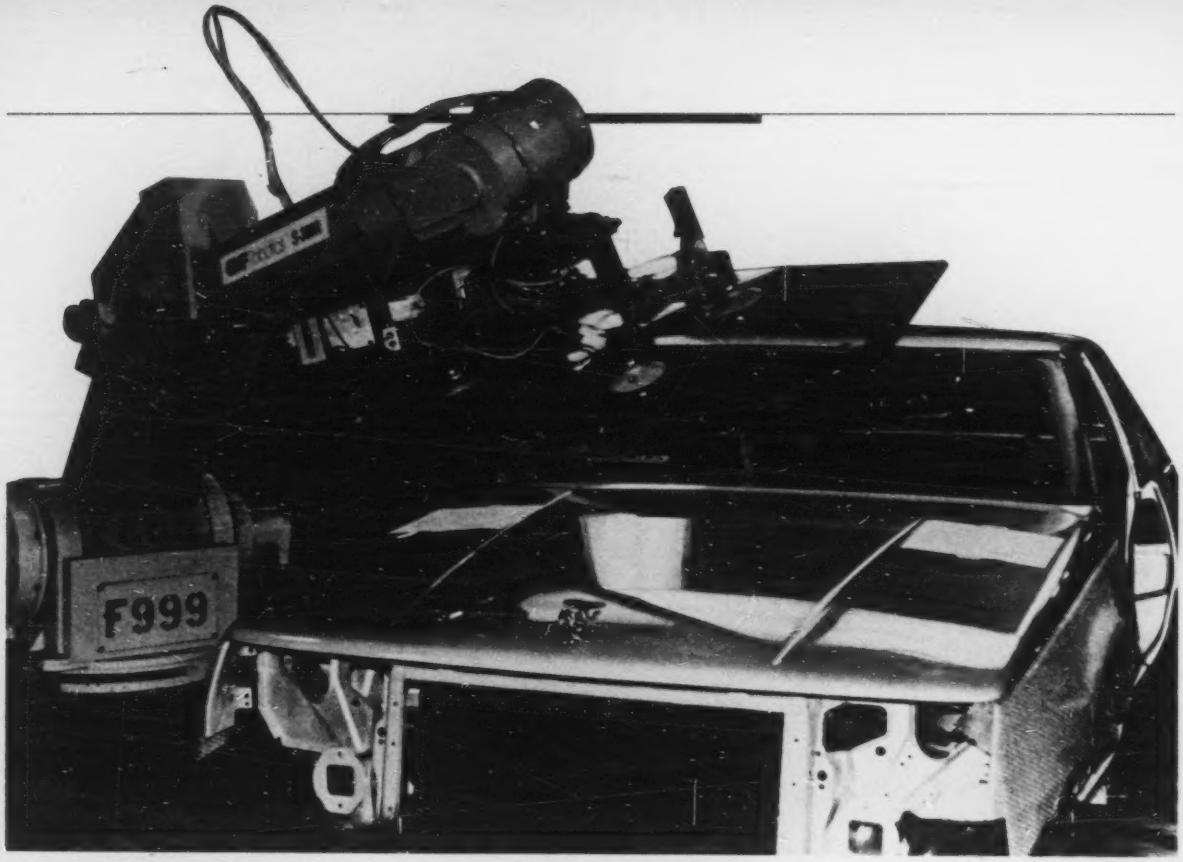


The first major issue facing the industry is determining which of the competing technologies will win out. Several various types of automated technologies currently are competing in the marketplace. Bar code systems are by far the most popular, claiming over 90 pct of the market, especially in the industrial setting where their use is expected to climb dramatically by the end of the decade.

But an assortment of other technologies is competing for a larger share of the market now dominated by bar codes. These include Optical Character Recognition, or OCR; machine vision; image processing and transmission for personal computers; microwave and radio frequency (RF) systems; keyboard data entry; magnetic strips; and voice technology.

"The most serious competition to the bar code industry comes from optical character recognition technology," concluded a recent report issued by International Resource Development Inc., a Norwalk, Conn, research firm that has analyzed both the bar code and OCR markets.

"There are several advantages to OCR in certain applications. It is directly legible to a human worker; it can



GM's Buick City plant is expected to use bar coding technology within its operation.

be printed more easily than bar code; it allows denser encryption; and so forth."

But the report also noted that present-day OCR systems are not as reliable as their bar code counterparts. Also, they operate less rapidly. More significantly, OCR often is more expensive.

"OCR competes with bar coding most effectively in certain POS and materials handling applications," concluded the IRD report. "There are many other applications, however, where the two technologies can be effectively used in concert."

Most industry analysts believe bar coding will win out, especially in the industrial environment.

"Bar code devices usually cost only a couple of hundred dollars, while devices like scanners and OCR readers are a lot more expensive," said Hedy Taub, an analyst with Future Computing Inc., a Dallas-Texas based market research firm.

One element fueling the market is the availability of new hardware and software programs for personal computers. This is helping to drive down the cost of installing parts identification systems for smaller manufacturers.

For example Computer Identics of Canton, Mass. recently introduced a product called Mac-Barcode for Apple's MacIntosh computer. Priced at $395, the software package can produce bar codes. However, it must be used in conjunction with a $600 Scanstar-Mac barcode reader which connects directly to the computer via the keyboard.

Industry officials believe the product will find a specialized niche, especially among small manufacturing companies attempting to comply with bar code specifications from the Defense Department.

Future Computing projects sales of all such personal-computer based equipment to soar to $40 million in 1986, up from $28 million in 1984. Specific figures for the industrial environment were unavailable.

Growing Industrial Use

International Resource Development projects, the most explosive growth in the bar code trade, will involve the industrial marketplace despite the fact that sales to this segment were relatively small before 1983.

"The most radical growth in the entire bar code industry will occur in industrial settings," said a recent IRC report. "Increased productivity will be needed if American industry is to remain competitive."

Company analysts believe that an increasing percentage of industrial capital and research-and-development funds will be plowed into productivity improvements like bar coding.

"It is universally predicted that CAD-CAM, flexible manufacturing, just-in-time delivery of components, LANs (local area networks for computers) integrated MRP, robotics and similar approached to saving time, money and labor will be pursued vigorously during the coming years," said the IRD report.

Company analysts predicted that the greatest potential for industrial bar coding is in allowing computers to identify batches of items during the manufacturing process. Then the computers can be programmed to instruct workers at stations throughout the production line

Auto Manufacturers Plans For Bar Coding Delayed

The automobile manufacturing industry has been among the strongest proponents of bar code technology, but the results so far have been mixed.

Deadlines for suppliers to meet bar coding standards have been rolled back several times because of equipment shortages and other delays. Chrysler, for example, originally set an Aug. 1, 1985 deadline for bar code compliance. But this was shelved after suppliers complained equipment shortages made it impossible to meet the goal.

More recently, General Motors set a June 30, 1986 deadline for its suppliers. Company officials said the date will stand, although they conceded it was likely many suppliers won't comply with it.

However, there are signs that the industry is beginning to toughen its view that bar coding is necessary for the industry's estimated 20,000 suppliers. G.M. plans to monitor compliance this summer and to send those who fail audits complaint notices.

"You receive enough complaint notices and it's no more business," one company official explained.

Don Heydens, a G.M. bar code expert and member of the Auto Industry Action Group (AIAG) said, "There has been some relaxing of the (June 30) start-up date. The real problem has been getting enough of the right kinds of equipment delivered on time."

G.M. has been sticking to its officially proclaimed date, although some suppliers won't be complying. "If you change the target, you never reach the goal," Mr. Heydens explained.

He estimated some 5,000 suppliers are involved in the effort. Some officials have estimated as many as 20 pct of the suppliers won't be in compliance at the deadline date.

G.M. currently is surveying its suppliers to measure compliance. Results should be available in September.

"Some of the very good suppliers are anxious to get going," said Mr. Heydens. "We're not progressing as fast as we should be. Not all suppliers are as willing as some of the others. The guy who supplies just one or two parts is somewhat reluctant."

While equipment shortages are a valid concern, some companies suppliers simply don't want to make the necessary capital investment. Under the G.M. guidelines a supplier can either purchase the equipment himself or purchase the bar code labels from an outside vendor.

Ford also is seeing resistance from its suppliers, which are estimated at more than 2,000. The automaker hasn't established a firm compliance date, but is urging its supply companies to go along.

Officials for both companies believe parts suppliers need to be convinced that the emerging bar code standard isn't just to benefit the large manufacturers.

"Bar coding wasn't meant to be a one-way street," said Mr. Heydens. "The beauty of the AIAG standards is that they can provide a benefit to both ends. We can use it on the receiving end to cut costs and they can use it on the shipping end for better efficiency."

Meanwhile, the manufacturers are proceeding with their own internal bar code systems. Some Ford engine and transmission division have utilized bar code technology for process and product control identification for four or five years. More recently, a casting and a glass plant have switched to the equipment.

G.M. is making greatest use of bar codes in its Buick City operation, although the massive Saturn Project, scheduled to go on line in 1989, will likely make extensive use of the technology.

All material that passes through 21 receiving docks at the plant is barcoded, and then automatically received, sorted and disbursed.

Previously the task was done by hand. Said Mr. Heydens: "The entire task used to be manual, with workers using note pads and clipboards."

what to do with items identified by bar code scanners at the locations.

"Acceptance of bar code technology by smaller factories will depend to a large extent on the availability of inexpensive, sufficiently accurate, reliable bar code printers and scanners," said the report.

But bar code equipment manufacturers already are getting the message about the industrial environment.

David J. Czaplicki, director of corporate communications for Intermec Corp., a bar code manufacturer based in Lynnwood, Wash. outside of Seattle, said the company has broadened its product lines to fit different industrial settings.

For example, one new hand-held scanner adapts to the assembly line and can read bar codes from longer distances in the factory.

Before 1983, most of Intermec's sales were to the grocery, health care and other non-industrial settings. Now some 80 pct of sales are industrial based.

"A lot more of our business is industrially oriented," said Mr. Czaplicki. The company switched its emphasis to this market in 1983. Intermec's overall sales grew from $26.9 million in 1984 to $43 million in the corporation's 1986 fiscal year which ended March 31.

He views the electronic manufacturing as "the largest segment of business we see."

"It's a high technology industry and it gravitates quicker to high technology solutions," explained Mr. Czaplicki. "The people in the electronics industry are not so afraid of the hard costs."

The Push to Standards

Two other industries that have propelled bar code systems growth are the auto industry and the defense industry. In both cases, key customers—General Motors Corp. for cars and the Department of Defense for weaponry—pushed adoption of the technology, as well as the emergence of standards.

In GM's case, as early as 1976 the industrial giant began requiring the use of bar codes on emission control com-

ponents built for cars and trucks. It since has broadened the use of bar codes to other major suppliers.

In fact, GM, Chrysler, Ford, American Motors and Volkswagen of America have joined together to release standards for the bar coding industry and its large supplier base, estimated at more than 28,000.

The Big Three U.S. carmakers joined forces through the 300-member Automotive Industry Action Group (or AIAG) to prod the industry-wide adoption of bar code technology.

But in some cases, there have been problems.

Chrysler Corp. was the most aggressive and the first automaker to announce, in January 1985, that all of its suppliers would provide bar coded parts by August.

But the deadline had to be rolled back for several months because increasing demand for bar code hardware resulted in shortages. An estimated 40 pct of Chrysler suppliers couldn't comply with the order because they couldn't acquire the technology, according to Chrysler officials.

Use of bar codes in auto manufacturing still is trailing behind earlier predictions.

"We're seeing the purchase of bar coding equipment going along more slowly than we originally thought," said Intermec's Mr. Czaplicki. "We thought it would pick up a lot faster than it did, but it is just not meeting the expectations we originally saw.

"There has been a lot of momentum in the auto industry. But it hasn't been carried through to the end suppliers."

Actually the defense industry was the first to mandate industry-wide adoption of bar code technology. The Department of Defense in 1982 began requiring suppliers to put bar codes on all parts and supplies shipped to military installations.

Adoption of the so-called Logistics Applications of Automated Marking and Reading Systems (or LOGMARS) program was a major boom to the bar code industry. Originally, the DoD recommended the use of alpha-numeric legends under the bar code symbols, which eliminated the need for machine-readable technology.

But this requirement ultimately was dropped after competitive reliability tests showed that out of 1.2 million bar-coded labels, there were only four errors.

Eventually the LOGMARS bar code requirement is expected to impact more than 50,000 American manufacturers.

Competition Changing

Much like the computer industry evolved, industry officials like Intermec's Mr. Czaplicki see the bar code market changing into one where end users demand a systems oriented approach to solving their production or manufacturing problems.

No matter who wins the impending battle to supply the industrial market, one thing seems certain. Business is booming.

This trend is causing larger manufacturers to enter the bar code field with the aim of muscling out smaller, independent bar code manufacturers.

Hewlett-Packard, Burroughs, Data General, NCR, General Electric and IBM are prominently mentioned as large companies with expertise in high technology that are anticipated to emerge as key players in the bar coding industry.

Hewlett-Packard already is addressing the manufacturing. Six different divisions of the company are manufacturing bar coding equipment and devices. Among the recent introductions is a hand-held industrial computer for use in remote manufacturing data collection.

Claudia Devoux, a company spokesman, said HP's bar code equipment sales have grown from $40 million in 1984 to $47.5 million in 1985. Customers run the gamut from professional service providers like doctors to aerospace parts manufacturers.

"The Defense Department standards in 1982 signaled the first big move into bar coding," Ms. Devoux explained. "Now all kinds of different industries are jumping on the bandwagon—transportation, distribution, retail.

"We see the biggest growth taking place in manufacturing, to keep track of parts in the factory. The technology is critical to just-in-time manufacturing."

Independent companies like Intermec are responding to the pressure from larger operators by opening up new distribution channels and taking a more hands-on approach.

"The market is getting so widespread that people utilizing it are no longer the micronoids of yesterday," said Mr. Czaplicki. "They want a business solution to their problem. They look at the total cost, versus the return on their investment.

Intermec is purchasing its own distribution network for its products, and trying to make them more intelligent and less expensive.

No matter who wins the impending battle to supply the industrial market, one thing seems certain: Business is booming.

International Resource Development estimated the size of the industrial bar code market to grow from 40 to 60 pct annually from 1984 sales of $170 million. By the end of the decade, sales should exceed $1 billion annually.

Nearly 150,000 factories in the U.S. are candidates for bar code equipment. Most will utilize it for simple inventory and labeling, with smaller numbers acquiring it for heavier automation tasks.

"The bar code industry is a healthy one," IRD concluded. "At present it is not seriously threatened by the advocates of other technologies."

While the Defense Department, grocery industry and health services all have boosted use of bar codes recently, industry proponents believe the technology will ultimately triumph in more traditional settings for two simple reasons: It saves money. And it increases productivity.